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EXAMINER	
WONG, LINDA	

ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/821,390	WALLACE ET AL.	
	Examiner	Art Unit	
	LINDA WONG	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 November 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments filed 11/12/2009 have been fully considered but they are not persuasive.

   a. Regarding claims 1,13,21,34,39,42,47,53,54,55, the applicant contends the prior art, Kishigami et al, fails to disclose “selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value”.

   The examiner respectfully disagrees. As indicated in the rejection, the limitations "each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value” is disclosed in the creation of the correlation matrix using Col. 4, lines 50-51 and col. 14, Eq 33. The examiner would also like to point to Equation 12. A basic matrix will have row(s) and column(s). Equation 12 shows the scalar vector ($a(\theta)$) is multiplied with the unitary matrix (Q_M), wherein the output b would be a matrix, wherein a matrix has rows and columns. Since the steering or scalar vector ($a(\theta)$) is multiplied with the matrix, at least one scalar would be found for at least one row. Col. 14, Eq. 33 shows the scalars would be real and/or complex.

   Regarding the limitation “selecting at least one different combination of scalars”, Col. 4, lines 50-51 discloses the steering vector or scalar vector is determined from the arrival angle evaluation function of Eq. 4. Col. 4, lines 15-50 discloses the calculating of the predetermine angle step (change in angle) is

determined based on the eigenvalues and eigenvectors as discussed in Col. 1-2. Col. 2, lines 1-20 discloses the varied angle or change in angle set is dependent on the number of incident waves, wherein the number of incident waves is determined based on a selection model as discussed in the prior art listed in the column. This indicates that a selection must occur in order to determine the change in angle, which affects the scalar or steering vector used in Eq. 12.

The applicant further contends the prior art, Kishigami et al, fails to disclose "forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars".

The examiner respectfully disagrees. Eq. 12 shows the steering vector or scalar vector is multiplied with the unitary matrix, Q_M, wherein when multiplying a matrix with a vector, the output would be a matrix.

2. Regarding claims 2-12,14-20,22-33,35-38,40-41,43-46,48-49,51-52, such claims are dependent to respective independent claims. Please see the rebuttal above the independent claims.
3. Based on the rebuttal above, the previous rejection stands as stated. A copy is provided below.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. **Claims 1-3,5-6,10,15,17,19,21,24-25,29,32-33,35-36,40-42,45-52** are rejected under 35 U.S.C. 102(e) as being anticipated by Kishigami et al (US Patent No.: 6642888).

   a. **Claims 1,17,**

      i. Kishigami et al discloses

         - "obtaining a base matrix" (Equation 12, label Qm as the base matrix)
         - "selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value" (Equation 12, label a(θ) as the scalar vector, wherein the scalar vector contains scalar values selected for a specific array antenna. (Col. 4, lines 50-51 discloses a(θ) is produced for the array antenna, wherein θ can be selected for a specific antenna. Based on the laws of multiplying matrices', the scalar vector can be multiplied with any of the rows and columns in the matrix, Qm. Col. 14, line 15, equation 33 shows the elements in a(θ), wherein the values can be real or complex depending on θ.) and

- "forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars". (Equation 12 in Col. 6, line 26 discloses multiplying the base matrix, Qm, with steering vector or scalar a(θ), wherein b(θ) is a modified steering vector. Col. 19, lines 9-15 discloses the Qm and a(θ) is a unitary transform of R, the correlation matrix or steering matrix.)

b. **Claim 2**, Kishigami et al discloses "forming a plurality of steering vectors with columns of the at least one steering matrix". (Equation 12 discloses a modified steering matrix using a(θ), wherein a(θ) can be computed for multiple θ.)

c. **Claim 3**, Kishigami et al discloses "the base matrix is a unitary matrix having orthogonal columns." (Col. 6, line 25 discloses the base matrix is a unitary matrix. Such a matrix is used to compute the steering vector b(θ), which can be used to produce R matrix. (Fig. 10 shows the correlation matrix R transformed in to a unitary equivalent using Qm, a(θ).) R matrix is the correlation matrix containing eigenvectors, such vectors are orthogonal, thus Qm would have orthogonal elements.)

d. **Claims 5,14,18,27,37**, Kishigami et al discloses the base matrix is a unitary matrix, wherein Walsh matrix is a type of unitary matrix. (Col. 6, line 25 discloses the base matrix is a unitary matrix.)

e. **Claims 6,15,19,29,** Kishigami et al discloses "each of the at least one steering matrix has orthogonal columns". (Equation 12 shows the equation for

producing the unitary transform of matrix R, wherein matrix R is orthogonal, thus would have orthogonal columns. (Col. 19, lines 9-15 discloses the Qm and a(θ) is a unitary transform of R, the correlation matrix or steering matrix. Col. 1, lines 44-67 discloses R is orthogonal.)

f. **Claim 9,31**, Kishigami et al discloses "each of the at least one steering matrix includes elements having equal magnitude." (Equation 12 discloses the production of the vectors of the steering matrix R, wherein depending on the calculation of b(θ), R can have elements with equal magnitude.)

g. **Claim 10**, Kishigami et al discloses "the base matrix has a dimension of N by N, where N is an integer greater than one, and wherein each combination includes N - 1 scalars for N - 1 rows of the base matrix". (Col. 1, lines 44-45 disclose the correlation matrix is a MxM matrix. Line 25 indicates M > 1. Since the base matrix is used to produce a unitary transformation of the correlation matrix, the base matrix would also have the same dimension as the correlation matrix. Equation 12 shows scalar multiplied with the base matrix, wherein the number of scalars and rows would depend on the number of elements in a row of the matrix and scalar vector.)

h. **Claim 21** inherits all the limitations of claim 1, but claim 1 fails to recite "processing data to obtain a block of data symbols to be transmitted in a plurality of transmission spans" and "performing spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the

block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices." (Fig. 18, labels 89-1-89-L shows the plurality of transmission, label 71 determines the block of data symbols to be transmitted. Col. 6, lines 11-16 disclose the correlation matrix is used for spatial smoothing. Fig. 18, label 63 determines the arrival direction using equation 12 and correlation matrix R, wherein the spatial processing or smoothing involves observing the channel. Regarding the limitation, plurality of transmission spans, Col. 1, lines 20-25 discloses the accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

i. **Claim 24**, Kishigami et al discloses "the plurality of transmission spans correspond to a plurality of time intervals." (Col. 1, lines 20-25 discloses the accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

j. **Claims 25,35,40**, Kishigami et al discloses "each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span." (Fig. 18, labels 89-1-89-L shows the multiple antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have 1 column.)

k. **Claims 26,36,41**, Kishigami et al discloses "each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span". (Fig. 18, labels 89-1-89-L shows the multiple

antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have more than 1 column.)

l. **Claims 32,33**, Kishigami et al discloses “the plurality of steering matrices’ are unknown to a receiving entity for the block of data symbols" and “known only to the transmitting entity." (Fig. 18 shows a transmitter, wherein the transmitter does not have a connection to a connecting receiver for sending the steering matrices' used to produce the data transmitted. Thus, the receiving entity would receive the data without knowing the steering matrices' used.)

m. **Claims 34,39** inherit all the limitations of claim 21.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 12,53-55** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888).

   a. **Claim 12**, Kishigami et al discloses “the at least one combination of scalars is obtained with a base-K counter having one digit for each of the at least one scalar in a combination, where K is the number of different possible scalars usable for each row of the base matrix”. (Col. 13, lines 15-20 discloses k is

used to determine the k-th element.) Although Kishigami et al fails to disclose "a base-K counter", a base-K counter is found in software or hardware in order to keep track of the element being used so to not run past the total number of elements. It would have been obvious to one skilled in the art at the time of the invention to use a base-K counter so to keep track of the number of elements in the vector and prevent an out of bound error.

b. **Claim 53** recites all the limitations of claim 1 but claim 1 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 1. A processor can have instructions or software for controlling the steps as discussed in claim 1. IT would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) so to easily calculate complex equations and provide an accurate calculation.

c. **Claim 54** recites all the limitations of claim 21 but claim 21 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 21. A processor can have instructions or software for controlling the steps as discussed in claim 21. IT would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) so to easily calculate complex equations and provide an accurate calculation.

d. **Claim 55** recites all the limitations of claim42 but claim 42 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 42. A processor can have instructions or software for controlling the steps as discussed in claim 42. IT would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) so to easily calculate complex equations and provide an accurate calculation.

6. **Claim 4** is rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al as applied to claim 1 in view of Craw (NPL: “The Fourier Matrix”).

a. **Claim 4,28**, Kishigami et al fails to disclose "the base matrix is a Fourier matrix." Kishigami et al discloses the base matrix can be any unitary matrix (Col. 6, line 25 discloses the base matrix is a unitary matrix.), wherein Fourier matrix is a type of unitary matrix. (See reference The Fourier Matrix.) Thus, it would have been obvious to one skilled in the art to use a Fourier matrix, since the base matrix must be any unitary matrix.

7. **Claims 11,13** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al as applied to claim 1.

a. **Claim 11**, Kishigami et al discloses a correlation matrix R, is a MxM matrix, wherein R is used to produce the modified steering vector (Eqn. 12). The size of

the matrix depends on the number of antennas as shown in Fig. 18 (Col. 4, lines 5-10) and can be “a power of two”. It would be obvious to one skilled in the art for N to be a power of two depends on the number of antennas as well as the inventors design choice.

b. **Claim 13** inherits all the limitations of claim 1, but claim 1 fails to recite the limitation "a memory operative to store the base matrix, or at least one steering matrix, or both the base matrix and the at least one steering matrix". Kishigami et al discloses a processor (Col. 1, lines 30-32), wherein memory is common in a processor. It would have been obvious to one skilled in the art at the time of the invention to incorporate a memory block to store the base matrix and/or steering matrix within the processor as disclosed by Kishigami et al so to allow for easy access to the information.

8. **Claims 22-23** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al as applied to claim 21 in view of Khatri (US Patent No.: 7020490).

a. **Claim 22,**

i. Kishigami et al fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as

disclosed by Kishigami et al so to provide independent phase and amplitude to avoid co-channel interference.

b. **Claim 23,**

i. Kishigami et al fails to disclose “multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval.”

ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies, wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al I so to provide independent phase and amplitude to avoid co-channel interference.

9. **Claims 42,45-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Khayrallah et al (US Patent No.: 6711124).

a. **Claim 42** inherits all the limitations of claim 1 or 21, but claim 1 fails to recite the limitations "deriving a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices", "obtaining, in the plurality of transmission spans, R sequences of received symbols via R receive

antennas, where R is an integer one or greater" and "performing receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols".

b. Kishigami et al fails to disclose such limitations.

c. Khayrallah et al discloses in Fig. 6 a receiver uses the channel estimate for equalization, wherein the channel estimates are produced based on the training sequences. (Col. 1, lines 29-42) The training sequences are produced using the scaling matrix as shown in Fig. 3. Fig. 4 shows a plurality of antennas, wherein the plurality of antennas would receive one or more sequences since each antenna would receive information. It would have been obvious to one skilled in the art at the time of the invention to incorporate the use of a channel equalizer as disclosed by Khayrallah et al into Kishigami et al so to eliminate interference within the signal after transmission by filter or equalizing.

d. **Claims 45 and 46**, Khayrallah et al discloses "each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one" and "each steering matrix has N columns and each spatial filter matrix has a dimension of N by R, where N and R are integers greater than 2. (Fig. 6 shows the receiver performing channel estimation and equalization. Fig. 7 shows the calculation of the channel estimation. Col. 7, line 58-Col.8, line 18 discloses the channel estimates are determined based on the scaling value matrix elements from the column corresponding to the antenna. Given the scaling value matrix is one by one, then the channel estimates would be a one by one matrix. Given

the scaling value matrix is N by R, wherein N and R are integers greater than 2, the channel estimate would be a N x R matrix.)

e. **Claims 47 and 50** inherits all the limitations of claim 42.

f. **Claims 48-49 and 51-52** inherits all the limitations of claims 45 and 46.

10. **Claims 43-44** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Khayrallah et al as applied to claim 42 in view of Khatri (US Patent No.: 7020490).

a. **Claim 43,**

i. Kishigami et al fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al so to provide independent phase and amplitude to avoid co-channel interference.

b. **Claim 44,**

i. Kishigami et al fails to disclose “multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval.”

ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies, wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al so to provide independent phase and amplitude to avoid co-channel interference.

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).
12. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LINDA WONG whose telephone number is (571)272-6044. The examiner can normally be reached on 9-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Payne can be reached on (571) 272-3024. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Linda Wong
1/28/2010

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